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MINISTRY OF HEALTH **HOSPITAL BUILDING BULLETIN No. 5**

Traffic Movements and the Inter-relation of Departments

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Introduction

1. The designer of a hospital is faced with a difficult task in deciding how best to locate the different departments of the hospital to achieve the best possible patient care and to facilitate efficient management. He has to take into account a number of factors, some of which affect all hospital building and others which are peculiar to the project he has in hand.

2. This Bulletin is concerned with only one of these factors—traffic movements and communications between the various departments of a hospital. It is an attempt to give guidance to designers on the optimum relationship of departments from the point of view of communications.

3. Because there are other factors than communications to be taken into account, solutions other than are suggested by this Bulletin will often be necessary. None the less, it is thought that this study of one of the important aspects of design will be of value to those who are planning hospitals.

4. If decisions on the siting of departments are based, as they must be, on a detailed knowledge of interdepartmental traffic, each new project will need a traffic study to produce the data synthetically for a new hospital, or by traffic surveys for extensions or alterations at existing hospitals. Such studies are expensive, difficult to stage, and are of limited value unless augmented by studies of traffic reduction and integration. Several countries have launched studies of optimum traffic inter-relation of some departments in hospitals but so far have not achieved a pattern for a whole hospital.

5. In order to provide a base-line against which local requirements and circumstances may be judged, the Central O & M Unit of the Ministry of Health has made a study of the nature and extent of necessary traffic in hospitals. This report records the results of the first part of the study. The second part, which is now in progress, is designed to provide usable answers to the problems of inter-relation in the whole hospital and to help avoid the duplication of effort which would otherwise occur if all project teams attempted individual comprehensive studies.

6. The study was based on information collected over a period of nine years and from many studies of the work of hospital departments and services. This was supplemented where necessary by collecting, with the assistance of Work Study officers employed by hospital authorities, additional information about interdepartmental movement.

7. The advice of doctors, nurses, architects and others both in the Ministry and in the Hospital Service was sought, in particular on the calculation of an appropriate evaluation structure for the various kinds of movement of people and goods found in a hospital. In addition, useful discussions were held with members of the Scottish Hospitals Development Group and the Department for Scientific and Industrial Research. Finally, we are indebted to London University, without whose new mathematical techniques, comprehensive solutions to the problems of inter-relation could not have been contemplated.

Foreword

8. The inclusion in the data of journeys which might be related to numbers of staff in each department was necessary only in order to estimate the extent of traffic involving staff and in no instance should they be interpreted as a recommended staff complement.

Scope

9. The present report is in four parts. They are:

Part I Conduct of the study

The initial calculation of the necessary direct and reciprocal traffic of people and goods generated by departments in a " model " 600-bedded district general hospital and assessment of the degree of importance of each traffic component, e.g. with regard to the need for speed of movement, frequency of movement or importance in the care of the patient.

Part II Traffic between departments

The assembling of the information.

Part III Uses of the first stage of the study

Limited application to the planning of extensions or adaptations of existing hospital building.

Part IV The second stage: the whole hospital

The traffic relationship of every department with every other and the final stages of the study.

Part I Conduct of the study

Collection of information

10. The most common method of studying traffic movements in hospitals is to record over a suitable period of time details of movements of people and goods between departments as they take place. Such studies make an important contribution to the development or rebuilding of an existing hospital, if only to show the existing pattern and type of movements and where organisational or building layout changes would simplify and improve communications.

11. Studies carried out in this way are, however, of less value as a means of providing general guidance in hospital building on the nature, type, and importance of traffic movements and the relationship in terms of traffic, between one hospital department and another. This is because of the wide differences which exist in the organisation, layout, methods of work, and general characteristics of one hospital compared with another which make it difficult to separate essential traffic movements from those conditioned by the peculiarities of each hospital. Non-essential traffic will include journeys unassociated with the business of the hospital, abortive journeys which a prior telephone call would have prevented or replaced and journeys which could be very considerably reduced in number by adopting different methods. Journeys peculiar to a particular hospital can arise because of the way in which the hospital has developed and the extent to which pressure on space may have caused departments to be divided or positioned in places which cause more traffic than would otherwise be accepted as desirable.

12. For these reasons this approach to the study of traffic movements was not adopted. It was considered preferable, in producing information to assist in the planning of new hospitals, to base the studies on an assessment of the traffic which would develop between departments and in services organised in a way which would avoid excessive or unnecessary movements; for example, to work on the basis of a hospital having an efficient messenger service following a recognised round of collections and deliveries, in place of many of the individual errands by nursing and portering staff which is at present a common practice.

13. It was possible to approach the study in this way because information on the needs of departments to communicate with each other and on collection and delivery services had been assembled over a number of years from studies made by the central O & M Unit and by O & M and Work Study Staffs of hospital authorities. As these studies had as one of their objects the simplification and improvement of methods it was possible to relate traffic needs to situations reflecting good practice.

14. In addition, traffic surveys of individual departments and of groups of departments in several hospitals have provided guidance on specific ratios, e.g. of beds to certain kinds of ward traffic, and a general check on the nature of hospital traffic. Field studies of the uses of pneumatic tubes, lifts and other mechanised forms of transport have also contributed.

15. Subject to the checks referred to in the previous paragraph the study took the form of creating a synthetic hospital organisation geared to a selected level of activity in its different departments but, for the first stage of the study, free of all preconceptions of site, distance or shape.

16. The type of hospital selected for the purpose of generating the data was a 600-bedded general hospital. It was necessary to select a particular sized hospital in the first place so that the extent and nature of traffic between departments could be calculated, but it was seen that once the relativities between departments had been determined these would remain valid broadly irrespective of size.

17. The hospital organisation visualised was one with the departments similar to those listed in Building Note No. 3, staffed on the basis of ratios of staff to work-load where these existed but otherwise on what seemed feasible or had been observed in hospitals of around 600 beds. For example, as there is no statistical relationship between the number of beds in a hospital and the number of out-patient and casualty attendances, the average for all acute and mainly acute hospitals in the 500–700 bed range was used.

18. The internal organisation of the departments and the general administrative arrangements were to be good; and *ad hoc* and routine work of the portering service would be planned and effective controls instituted; work loads were to be spread equitably over available time; imprest methods of supply would be in use where appropriate and the need to send nurses on errands such as to the pharmacy or to borrow stores from another ward would have largely disappeared.

19. Using this organisational framework, the type, frequency, bulk, and urgency of traffic necessarily generated, in and out, by each department was calculated. Consequently all traffic inessential to the business of a hospital was omitted and although account could not be taken of additional *ad hoc* traffic which is bound to occur, this factor will be common to all departments and will not therefore affect significantly the validity of subsequent comparisons.

20. These calculations produced, by nature and amount, the traffic links between eighteen departments or areas. The number was limited to eighteen because it was thought that, at least initially, this was the largest number that could be handled; it was achieved mainly by classing wards as a single " department ". By the time the first stage of the study had been completed it was found that no limit need be placed on the number of departments included.

21. This information was insufficient for the purpose of the study. To use it as it stood would imply that all traffic movements were of equal importance to the business of the hospital; this is not the case. The number of trips made or the number of people involved or the volume of goods carried are all numerically comparable but they do not provide an adequate measure of the need for some departments to be nearer to each other than others.

22. For example, two entries on a traffic survey record-sheet read as follows:

From linen room to ward
2 porters delivering clean linen
From operating theatre suite to ward
1 nurse and 1 attendant returning with in-patient

Both of these entries describe necessary traffic; both involve the movement of a load and both involve two members of the hospital staff. They are statistically the same but they must obviously have an unequal effect on the claims of the laundry and operating theatres to be near the wards. This is simply because it is more important to arrange the shorter journey for a patient who might need attention or be inconvenienced on the way than for a load of linen, and the requirement for a system of weighting the calculations is clearly indicated.

The evaluation of movements

23. Although studies made in hospitals have provided much information on priorities it was obviously desirable that the scale of weighting, or evaluation adopted, should reflect as much as possible the judgment of doctors, nurses and administrators who work in hospitals or who are otherwise concerned. But because there will always be varying shades of opinion, two additional measures were introduced as a check on the construction of the scale of evaluation to see if its application produced acceptable results.

Checks on evaluation

24. The two checks were:

(*a*) *Axiomatic relationships*

There are a number of local arrangements of departments in a hospital which are generally accepted as being correct because their advantages in practice have become apparent and experience has not suggested any better alternative. For example, the links between a medical records department and an out-patient department are so strong that it is difficult to imagine any acceptable plan which made them difficult of access to each other. Where any scale of evaluation therefore tended to divorce departments from each other when axiomatically they should be together or, conversely, brought into prominence a department the siting of which is known to be less critical than others, then, provided that the basis of attraction or otherwise was essentially that of traffic, it was reasonable to assume that the evaluation was at fault.

In the event, after some trial runs, the scale which coincided most closely with the consensus of judgment was found to reproduce axiomatic situations and there was therefore good grounds for accepting that the valuation was realistic in indicating optimum siting of departments on the basis of communication needs.

(*b*) *Field trials*

For this test two very old former local authority hospitals were chosen. Both hospitals had expanded considerably over the years and as the variety and extent of the services provided changed, unoccupied parts of the sites had been filled in. Some of the buildings had been demolished and new ones had taken their place. As a result orderly development had been impossible, many of the departments and services had been forced into unsuitable locations and traffic routes were often long and inconvenient. Nevertheless, as hospitals and, very noticeably, as communities, both appeared to function admirably and many difficulties had been diminished by good planning and control of collection and delivery services, though this was a tribute to the people who worked in them rather than to the buildings in which they worked. There was, therefore, a very keen awareness of the disadvantages to which badly sited departments gave rise and decided views on where they would be better situated.

These views were collected from ward sisters and heads of departments and in each case the question asked was:

> "If all the departments in the hospital could be re-arranged, in what order of proximity to your own department would you place them, having in mind only the advantages which would accrue to your own department?"

Few of those asked went beyond naming three or four departments, classifying the remainder as being of lesser and of roughly equal significance to their work.

Comparisons were subsequently made between these views and the results indicated by the evaluated data and were found to coincide in the majority of cases.

The scale

25. With the confirmation provided by these two checks, it was decided to adopt the scale of evaluation described below; as is true of all stages, revisions in the light of new evidence or change can be rapidly incorporated.

26. The following three factors in relation to all types of traffic were evaluated:

FREQUENCY AND TYPE
BULK
URGENCY

Frequency and type

27. The number of journeys are those which take place over 24 hours and the number of points allotted *to each single journey* (between departments or between a department and outside the hospital) is as follows:

(*a*) *The movement of people*

In-patient	4 points
Out-patient day-patients	4 points
Out-patient with escort	2 points
Medical staff	4 points
Nursing staff	3 points
Members of professions supplementary to medicine and other professional and technical staff	3 points
Other staff	1 point
All staff (meals on/off duty, etc.)	½ point
Visitors	½ point

Example: Nurse and attendant accompanying in-patient equals 8 points.

Compensating adjustments for "round-trips" are made in accordance with the method described at Appendix A.

(*b*) ***The movement of goods***

Appropriate points for each person moving goods plus weighting as shown below under "bulk".

(*c*) ***The movement of vehicles***

Ambulances and contractors' vehicles	10 points

Bulk

28. The number of points shown are added for each single journey.

Very bulky (requiring mechanical aid)	2 points
Bulky (but can be carried by one person)	1 point
Light (e.g. papers, briefcase)	No addition

Example: Porter taking large bundle of case-notes from medical records department to out-patient department equals 2 points.

Urgency

29. The numbers of movements of people and goods are in themselves concrete data which, when evaluated, can be aggregated and used for comparisons of density and importance of traffic between departments. There is, however, a third ingredient, that of "urgency" of movement, which, if it occurs, must outweigh in significance and as a criterion for proximity of departments, any other type of routine traffic. It is therefore necessary to give due weighting to any element of urgency which can be shown to exist, before arriving at a comprehensive evaluation.

30. Studies in this country, and in the U.S.A., have shown that the need for urgency in the movement of people and goods around hospitals is minimal and there is little evidence that hospitals would function better if traffic moved more quickly.

31. In a well-organised hospital, whether old or new, traffic routes, ordering, collection and distribution will have been studied and goods and services made available at the places and times they are required. There is no special virtue in speed, and hurried journeys from one hospital department to another are more likely to be the result of organisational failing than of actual need. Additional support for this statement was derived from a recent survey during which records were kept by ward sisters of the occasions when it would have been of advantage to have somebody or something arrive at the ward more quickly. The majority of sisters gave a "nil" return and where such occasions were recorded, these, for the most part, could be traced to human error usually involving either an inability to supply or a failure to make a demand. But even this reason for urgency is slight and in many hospitals the adoption of imprest methods of supply based on carefully calculated normal requirements backed by adequate arrangements for meeting exceptional demands, has done much to reduce it.

32. What remains therefore is a consideration of urgent movement of people or goods which may have to take place as the result of an emergency. This can arise when, although the existence of a demand is known, the size or some other variant of that demand cannot always be forecast; or when, because certain goods have a short stock-life or have to be stored at a particular temperature, it is difficult to maintain secondary storage points at a level which will always meet current requirements.

33. Where between departments the possibility of an emergency movement can still be held to exist, a weighting sufficient to ensure that this consideration outweighs any other is applied.

Part II Traffic between departments

Individual departments

34. The study described above produced for each hospital department a series of numbers, each of these numbers relating to a traffic link with another department. The size of the number reflects the degree of priority attaching to the movement. The larger the number, the greater is the need for proximity.

35. This information, with a brief description of the assumed characteristics of each department and its organisational arrangements, is given at Appendix B (1–18) for each of the eighteen departments. The Appendix also gives the number and nature of the journeys to and from each department and includes for each department a diagram which shows in descending order of importance the evaluated traffic links between an individual department and the other seventeen.

36. A first step was to consider the use of a computer for each set of relationships because the information to be processed was in numeric form. But there emerged very strong reasons for not using a computer at this stage.

37. Among these were:

(*a*) Separate solutions in respect of each hospital department would have resulted, involving repeated use of the computer.

(*b*) None of the solutions would have represented more than a "selfish proliferation" of one department.

(*c*) The solutions would have contributed nothing to the second stage of the study which has to reflect, in one pattern, the optimum location on the stated criteria of every department in relation to every other and still remain "free floating", i.e. not conditioned by the preconceived siting of any department.

38. A much more useful and less expensive alternative to the use of a computer at this interim point was therefore evolved in order to show comparative relationships

diagrammatically by bringing closest to each " subject " department, those departments with the highest weightings.

39. This was achieved by taking for each department the reciprocal of the numbers denoting the importance of its traffic links with other departments and then (only as an arithmetical device) multiplying throughout by a convenient number to enable the converted figures to be used for locating departments at comparative distances along lines of pre-determined links radiating from the subject department. A typical example of a diagram constructed in this way appears at Appendix C and notes on the method of construction at Appendix C (1).

40. The use of reciprocals is merely a means of bringing departments with the highest weighting nearest to the centre of the diagram so that a picture is presented in which the lengths of the lines radiating from the centre indicate their importance; the shorter the line, the more important the contact. It would be possible to draw diagrams without this device but the picture would then be reversed; the longer lines would indicate the more important contacts and it would not be possible to proceed to the next step in this method—the manual integration of the information shown on the diagrams.

All departments—manual methods

41. The problem now to be solved is how to interrelate all this information so that the traffic links which should be kept short gain that degree of priority as a result of appropriate arrangements of departments in relation to every other. It is important to stress at this point that the information being handled is necessarily two-dimensional. It pays regard to the position of departments in the same way as they could be portrayed on a drawing board or as squares of wood might be moved about on a flat surface. The resultant best arrangement will at this stage directly relate only to a hospital of single-storey buildings, a very uncommon form of construction for modern hospitals.

42. All the information to achieve the best arrangement of departments in terms of traffic is available in the tables at Appendix B (1–18) or in a more concise form in the matrix at Appendix D. At first sight the problem seemed capable of representational or mathematical solution but this, however, was not the case.

43. Two manual methods are possible:

(i) The relationship illustrated in a set of reciprocal diagrams can be re-drawn and grouped into three or four " bands " of relative importance each distinguished by connecting links of different thicknesses communicating with the connecting departments. Departments will then be associated together empirically by way of paper drawings in which the " heavy " lines and then " medium " lines are kept as short as possible.

(ii) By using reciprocal diagrams and starting from the " shortest " and most important contexts shown in the diagrams, to build up networks in a way which ensures that the most important contacts are kept together in a rising number of interdepartmental associations.

44. In the method described at 43 (i) above, the complexity of intermeshing departmental relationships is simplified by grouping their variety into only three or four " bands ". In using the method described at 43 (ii) the simplest device is a planning board of the type illustrated at Appendix E. This produces a number of alternative solutions by joining each position (each hook on the board) to others by means of rubber cords cut to appropriate proportionate lengths and then rearranging them on the board, maintaining as uniform a degree of tension of the cords as possible. The method is impracticable for more than five or six departments and the solutions are at best only approximate.

45. The methods subsequently adopted for solving the problem of inter-relating every department with every other are described in Part IV of this report.

Part III Uses of the first stage of the study

46. At this stage, the details presented give a picture in the abstract of the traffic associations between eighteen hospital departments. At least two further factors need to be included before the information can be used (other than as a very general guide to departmental relativities) in the planning of new hospital buildings. These two additional factors are space and the subdivision of " wards " into the full range of specialist units for which provision needs to be made. These and other factors will be included in stage 2 of the study as described later. Reference is made to the limitation of the first stage of the study here and at paragraph 41 to ensure that the information is not used otherwise than as intended.

47. However, the information will be of some assistance when considering additions or alterations to an existing hospital. A possible method of use is described in the following paragraphs.

48. Changes to existing hospital buildings are likely, in the main, to include the rebuilding or construction of a limited number of departments and, in considering their siting or the effect on traffic or interdepartmental relationships between one proposal and another, it will be useful to be able to compare local judgments against a base line such as that set out in this report, if only to provide a challenge to what is thought to be the best arrangement.

49. The information in this report cannot be used as it stands as guidance to what is the best inter-relationship between two or three departments and the rest of an existing hospital because the information has been

built up synthetically on the premise of well-organised departments using efficient traffic methods; these considerations might not apply to the hospital to which changes are to be made, or there may be complications inherent in the main part of the old hospital building which hamper the introduction of the best arrangements.

50. The first step therefore—which will be necessary in any case—is to undertake a traffic survey to determine for the area or alternative areas affected by the redevelopment and the rest of the hospital what are the lines of communication and traffic movements. If this is done on the lines described in Part I and Part II of this report it will become possible to compare the results with those representing "normal" conditions as set out in Appendix B (1–18) to this report; or to construct reciprocal diagrams as described at Appendix C and C (1), or to work on the basis of comparison with the matrix shown at Appendix D.

51. Differences revealed are likely to be due to (*a*) variations in the size or characteristics of the hospital as compared with the model used in this report or (*b*) these differences having been allowed for, differences of method or in the number and frequency of journeys.

52. For example, apparent heavy traffic involving ward staff and the pathology laboratory or the pharmacy may counsel not a closer physical association between these departments and the wards to save nursing time, but the reduction of the number of journeys and the transfer of much of the work from nursing staff to porters by the introduction of an effective messenger service. One recent assessment of this kind resulted in the replacement of over seventy journeys undertaken daily by ward staff by four journeys undertaken by messengers. Comparisons of this kind will help to avoid carrying over into the new building methods of work which could be improved.

Part IV The second stage—the whole hospital

53. None of the methods described earlier in this report is capable of providing a solution for the number of departments involved in a whole-hospital concept and enquiries in many fields only served to confirm that there was no known method available of solving the problem either manually or, because there were no mathematics to support it, on a computer.

54. But with the co-operation of the Department for Scientific and Industrial Research, contact was finally established with a member of the staff of London University who was currently conducting research into a similar problem concerning optimum siting for industrial processes and who was evolving for this purpose new mathematical techniques. These techniques are equally applicable to the siting of hospital departments.

55. These new mathematical techniques now make it possible to complete this investigation and to produce for hospitals of differing basic shapes, e.g. single-storey, multi-storey or of mixed layout, the optimum association of departments to reduce movements, save operating costs, and to provide efficient communication services essential in the treatment of hospital patients. In addition it will enable comparisons on the lines of those described at paragraphs 50–52 above to be carried out more effectively.

56. The initial stages of the study described in this report have dealt with the methods evolved for the fashioning of a planning tool as well as with the data, evaluation structure and the programming of a mathematical technique. The second phase which will be published later will contain fuller information on the organisational details of each department and its method of working, size and throughput, in amplification of the information given at Appendix B, and it will describe some of the results which have already been obtained.

57. Additional factors on which work is now progressing are as follows:

(i) ***Increasing the number of departments***

Until recently it was thought that a matrix involving between 14 and 18 departments was the largest for which reliable solutions could be expected but from the latest tests made of the validity of the mathematics on computers in London and Manchester, it seems likely that the number of "departments" included in the matrix can be increased considerably without any reduction of confidence in the results produced. The most important effect is that the "Wards and Special Departments" can now be split into their appropriate elements (e.g. medical, surgical, geriatric, maternity, intensive care), each of which may then be regarded for the purpose of the study as a separate "department" with individual traffic needs which can be defined. It also becomes feasible to include movement which is not in the present context interdepartmental, e.g. the removal of certain items of waste.

(ii) ***Incorporating constraints***

Although generally the most important criterion for the siting of departments may be that of traffic, there are of course other considerations which can override, intensify or diminish this need for departments to be near each other. For example, the movement of staff between residential accommodation and the wards would tend to attract these two "departments" to each other when only the traffic criterion is used but there are stronger reasons for siting residential accommodation away from the wards and from the main traffic routes.

A list of some of the additional factors of this kind which have generally to be taken into account when considering the siting of departments in hospitals has been provided by the Ministry's Architectural Division and is reproduced at Appendix F. These factors may at a later stage be built into the computer programme as constraints and their aggregate effect reflected in solutions.

In addition, studies are being made of the effect on interdepartmental relationships of the introduction in some sectors of automated movement and communication aids which may tend to diminish the needs of departments involved to be physically closely related.

Conclusion

58. A main feature of the study in both the manual and computer stages is its flexibility. The evaluation structure and data can be revised very easily, new departments can be included or existing ones excised, and the effects on siting can be examined of splitting a department or combining the functions of two or more.

59. The present evaluation structure evolved as described earlier, looks forward to some extent to take account of the increasing emphasis on out-patient and day-patient treatment, and the growing need to provide conveniently arranged diagnostic and treatment facilities so that all the requirements of such patients can be met within available time. This was provided for by increasing the points allocated to journeys of all categories of out-patient.

60. Similarly, any other changes in hospital practices and new ideas in hospital development can be reflected in solutions by relatively simple adjustments to the data and to the evaluation structure.

Appendix A

ALLOCATION OF POINTS FOR ROUND TRIPS

Number of collection/delivery points	*Single trip method: No. of radii*	*Round trip method* $2r + 2\pi r$	*Percentage saving*	*Percentage of points allocated*
5	10	8½	15	85
10	20	8½	57½	42½
15	30	8½	71⅔	28⅓
20	40	8½	78¾	21¼
25	50	8½	83	17
30	60	8½	85⅚	14⅙

Note: Each single trip is counted as two radii of a circle. A round trip is counted as two radii plus one circumference, i.e. approximately 8½ radii of the same circle.
Tests using the middle range of points (15–25) on widely differing hospital designs support these figures to within ± 5 per cent.

Appendix B (1) (Data)

Department: Wards (20 × 30 beds)
Code Number: 1

Movement—in and out (24 hours)	*Number of journeys*	*Department, code*	*Assessment*
In-patients			
Admissions (Booked and Emergency)	22	10	154
	18	8	126×2
Operating Theatre Suites (12)×24	72	2	288×2
Ex. Accident and Emergency (4)×12	12	2	48×2
Diagnostic X-ray (21 in-patients)	42	5	224
Pathology	—	6	—
Physical Medicine (special equipment, etc.) (6)	12	7	60
Discharges and Transfers	36	16	144
Staff			
(1) Ward Nursing/Orderly/Domestic			
On duty	105	18	13
	155	16	19
Off duty	105	18	13
	155	16	19
Meals and breaks	780	12	97½
Administrative offices (including Matron's)	40	9	5
Errands (reduced by effect of messenger service to less than one per bed per week)	48	6	96
	44	3	88
	14	10	28
	14	13	28
(2) Medical and Nursing Administration	20	16	80
	2	9	51
Rounds and Visits	40	18	160
(3) Physiotherapists/Occupational Therapists (8)	48	7	144
(4) Laboratory Technicians (2) 2 Round trips	4	6	51
(5) Radiographers (1½ cases per day)	3	5	15
(6) Almoners Round trips	1	9	9
(7) Chaplains Round trips	1	9	9
(8) Maintenance (based on planned annual programme)	—	17	35
Visitors (relatives, etc.), 1·5 per occupied bed	1530	16	191
Other Visitors (voluntary organisations, etc.) Round trips	6	16	6
Deliveries			
(1) Meals (2 trolleys per trip): with trolleys	30	12	90
without trolleys	30	12	30
(2) Sterile supplies—combined collection and delivery. One trolley-load per 90 beds	14	11	42
(3) Drugs, medical requisites } Round trips	3	3	43
(4) Dangerous drugs } *Ad hoc*	10	3	10
(5) Surgical appliances	—	—	—
(6) Clean bedding, linen, patients' clothing, etc. (1½ wards per load)	26	15	78
(7) Stationery (monthly) Round trip	1/30	13	¼
(8) Cleaning materials (fortnightly) Round trip	1/14	13	1
(9) Hardware and crockery (monthly) Round trip	1/30	13	½
(10) Washed crockery	80	12	160
(11) Provisions (dry) (weekly): 6–7 wards per load Round trips	½	13	11
(12) Provisions (daily milk, bread, pastry) Round trips	6	13	153
(13) Case-notes (50% by routine messenger service)	40	10	40
(14) X-ray films (75% by routine messenger service)	10	5	10
Collections			
Mortuary	3½	14	17½
Food trolleys: with trolleys	30	12	90
without trolleys	30	12	30
C.S.S.D. items returned (see Deliveries)	—	11	—
Soiled bedding and linen (5 wards per load) Round trips	4	15	68
Crockery for washing	80	12	160
Case notes (majority by routine messenger service)	20	10	20
X-ray films (by routine messenger service)	—	—	—
Collection/Delivery of post Round trips	3	3	3
	3	4	3
	3	5	3
	3	6	3
	3	7	3
	3	8	3
	3	9	3
	3	10	3
	3	12	3
	3	13	3
	3	17	3
	3	18	3

APPENDIX B (1) (Data) (continued)
Department: Wards (20 × 30 beds)
Code Number: 1

Movement—in and out (24 hours)		*Number of journeys*	*Department, code*	*Assessment*
Routine messenger service Collection/Delivery of all other items (for other departments) such as reports and requisitions	Round trips	8	2	7×2
		8	3	7
		8	4	7
		8	5	7
		8	6	7
		8	7	7
		8	8	7
		8	9	7
		8	10	7
		4	11	3½
		8	12	7
		8	13	7
		8	15	7
		8	17	7
		8	18	7

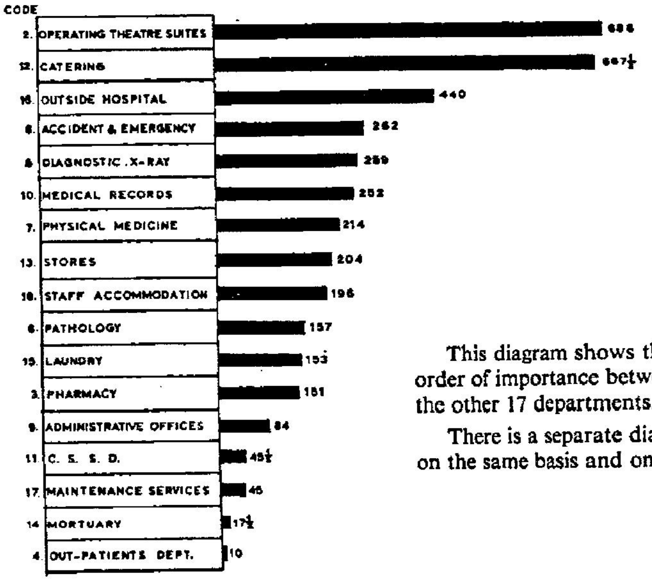
ANALYSIS

1	2	3	4	5	6	7	8	9
—	686	151	10	259	157	214	262	84
10	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
252	45½	667½	204	17½	153	440	45	196

Notes

1. Hourly routine messenger service.
2. Frequency of supplies deliveries is as shown in data.
3. Visitors: 1·5 per day per occupied bed on average.
4. Errands undertaken by ward staff in exceptional circumstances only; no more than one per occupied bed per week by entire ward staff.
5. Central crockery washing service; trolleys retained on wards.
6. Average daily bed occupancy = 86%.
7. Average length of stay = 16·5 days.
8. Number of cases = 11,500 per year.

WARDS AND SPECIAL DEPARTMENTS



This diagram shows the evaluated traffic links in descending order of importance between the subject department and each of the other 17 departments.

There is a separate diagram for each department constructed on the same basis and on the same scale.

Appendix B (2) (Data)

Department: Operating Theatre Suites
Code Number: 2

Movement—in and out (24 hours)	*Number of journeys*	*Department, code*	*Assessment*
Patients			
Wards (from previous data sheets)	—	1	686
Accident and Emergency (4)	12	8	48×2
Special examinations (X-ray)	2	5	16×2
Staff			
(1) Own Medical, Nursing, Attendant, Portering, etc.			
On duty	28	18	3½
	8	16	1
Off duty	28	18	3½
	8	16	1
Meals and breaks	108	12	13½
Ad hoc visits and errands	3	9	9
	2	6	6
	2	5	6
	2	3	6
	1	13	3
(2) Laboratory Technicians	2	6	12×2
(3) Radiographers	3	5	18
(4) Maintenance	—	17	6
(5) Nursing Administration Rounds	2	9	6
Visitors	4	9	½
Deliveries			
Sterile supplies	4	11	12
Blood, sera	2	6	4×2
Gases	2	3	4
Drugs, medical supplies	3	3	12
Instruments	2/7	3	1
Clean linen (daily)	2	15	8
Cleaning materials	1/14	13	—
Hardware	1/30	13	—
Provisions	2/7	13	4
Stationery	1/30	13	—
Collections			
Soiled linen (daily)	2	15	8
C.S.S.D. items returned	—	11	—
Mortuary	1	14	3
Containers	1	13	2
Pathology	2	6	6
Routine messenger service			
Collection/Delivery of all other items (for other departments) such as reports, requisitions, post — Round trips	8	3	7
	8	4	7
	8	5	7
	8	6	7
	8	7	7
	8	8	7×2
	8	9	7
	8	10	7
	4	11	3½
	8	12	7
	8	13	7
	8	15	7
	8	17	7
	8	18	7

ANALYSIS

1	2	3	4	5	6	7	8	9
686	—	30	7	63	51	7	110	22½

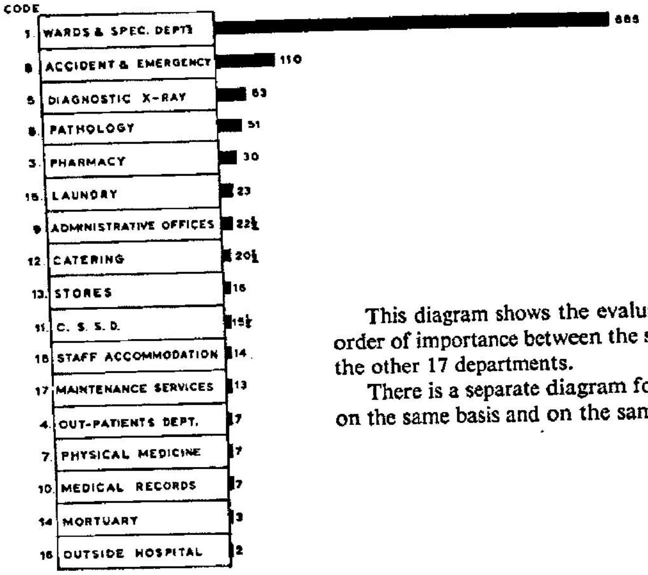
10	11	12	13	14	15	16	17	18
7	15½	20½	16	3	23	2	13	14

Notes

1. Hourly routine messenger service.
2. Assumed number of operations (daily average) = 16 (12 from Wards, 4 from Accident and Emergency Department).
3. Co-ordinated movement of patients to avoid delay.

APPENDIX B (2) (Data) (continued)

OPERATING THEATRE SUITES



This diagram shows the evaluated traffic links in descending order of importance between the subject department and each of the other 17 departments.

There is a separate diagram for each department constructed on the same basis and on the same scale.

Appendix B (3) (Data)

Department: Pharmacy (and Stores)
Code Number: 3

Movement—in and out (*24 hours*)		*Number of journeys*	*Department, code*	*Assessment*
Wards (from previous data sheets)		—	1	157
Operating Theatre Suites (from previous data sheets)		—	2	30
Out-patients (including 12 escorts)		48	4	168
		48	16	168
Staff				
(1) Own Pharmacists, Technical, Domestic Stores and Clerical Staff				
On duty		10	16	1½
Off duty		10	16	1½
Meals and breaks		20	12	2½
(2) Other Staff				
Ad hoc, stamp machines, etc.		3	8	6
		3	4	6
		1	6	2
		2	9	4
		2	10	4
Maintenance		—	17	3
Collections/Deliveries (own department)		5	16	50
Contractor's vehicles (Bulk Stores), 2½		1/14	13	—
Cleaning materials		1/30	13	—
Stationery		4/7	13	3
Medical and surgical supplies		1/30	13	—
Hardware				
Distributions/Collections (other departments), drugs, prescriptions, medical and surgical sundries, gases	Round trips	3	4	12
		2	5	8
		2	6	8
		3	7	12
		3	8	12
		3	11	12
		½	14	2
Collections/Delivery of post	Round trips	3	4	3
		3	5	3
		3	6	3
		3	7	3
		3	8	3
		3	9	3
		3	10	3
		3	12	3
		3	13	3
		3	17	3
		3	18	3
Routine messenger service Collection/Delivery of all other items (for other departments)	Round trips	8	4	7
		8	5	7
		8	6	7
		8	7	7
		8	8	7
		8	9	7
		8	10	7
		4	11	3½
		8	12	7
		8	13	7
		8	15	7
		8	17	7
		8	18	7

ANALYSIS

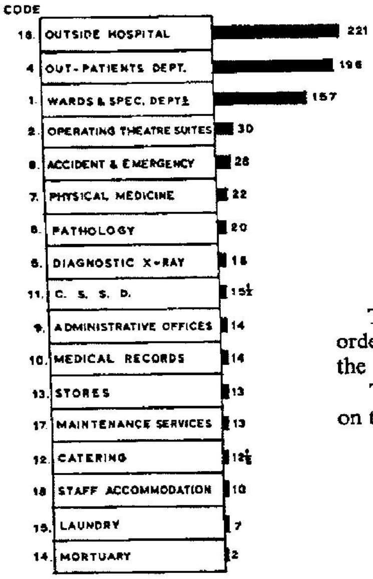
1	2	3	4	5	6	7	8	9
157	30	—	196	18	20	22	28	14

10	11	12	13	14	15	16	17	18
14	15½	12½	13	2	7	221	13	10

Notes
1. Hourly routine messenger service.
2. Own bulk stores.
3. Three delivery rounds per day.
4. Assumed that out-patients leave hospital after collecting medicines.

APPENDIX B (3) (Data) (continued)

PHARMACY (INCLUDING STORES)



This diagram shows the evaluated traffic links in descending order of importance between the subject department and each of the other 17 departments.

There is a separate diagram for each department constructed on the same basis and on the same scale.

Appendix B (4) (Data)

Department: Out-Patients

Code Number: 4

Movement—in and out (24 hours)	*Number of journeys*	*Department, code*	*Assessment*
Wards (from previous data sheets)	—	1	10
Operating Theatre Suites (from previous data sheets)	—	2	7
Pharmacy (36+12) (from previous data sheets)	—	3	196
Out-patients and Escorts			
Pre-registered (325 + 117 escorts)	442	16	1534
To Diagnostic X-ray (32 + 12)	44	5	152
To Physical Medicine (to make appointments) (9 + 3)	12	7	42
To Pathology Laboratory (21 + 7)	28	6	98
To Almoners (6 + 2)	8	9	28
Return to clinic area (16 + 5)	21	5	74
Return to clinic area (10 + 3)	13	6	46
Re-appointments (198 + 72)	270	10	936
Leave from clinic area (49 + 17)	66	16	230
Own Medical, Nursing, Clerical and Ancillary Staff			
On duty	16 24	18 16	2 3
Off duty	16 14	18 16	2 3
Meals and breaks	120	12	15
Ad hoc visits and errands	3 6	9 10	12 18
Other Staff			
Administrative rounds, etc.	2	9	6
Maintenance	—	17	4
Deliveries			
Clean linen	4/7	15	3
Case notes	4	10	6
X-ray films	4	5	4
Provisions	2	13	6
Cleaning materials	1/14	13	—
Hardware	1/30	13	—
C.S.S.D.	2	11	6
Stationery	1/30	13	—
Dressings	2/7	13	1/2
Collections			
Soiled linen	4/7	15	3
Case notes	4	10	6
X-ray films	4	5	4
C.S.S.D. items returned	—	11	—
Ambulances (9)	18	16	180
Collection/Delivery of post Round trips	3	5	3
	3	6	3
	3	7	3
	3	8	3
	3	9	3
	3	10	3
	3	12	3
	3	13	3
	3	17	3
	3	18	3
Routine messenger service Collection/Delivery of all other items (for other departments) Round trips	8	5	7
	8	6	7
	8	7	7
	8	8	7
	8	9	7
	8	10	7
	4	11	3½
	8	12	7
	8	13	7
	8	15	7
	8	17	7
	8	18	7

APPENDIX B (4) (Data) (continued)

Department: Out-Patients

Code Number: 4

ANALYSIS

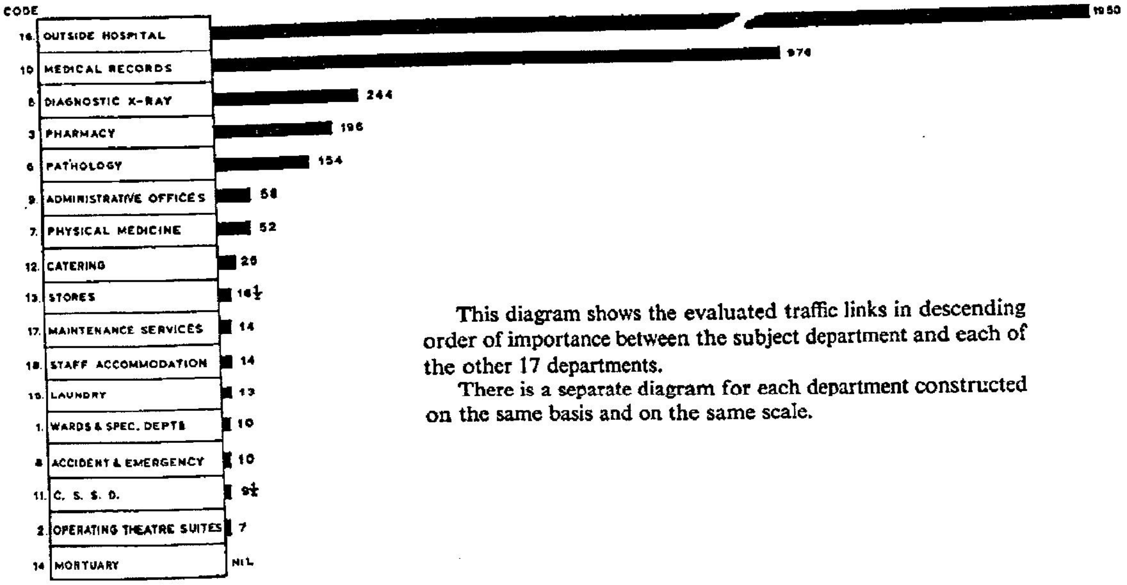
1	2	3	4	5	6	7	8	9
10	7	196	—	244	154	52	10	56

10	11	12	13	14	15	16	17	18
976	9½	25	16½	—	13	1950	14	14

Notes

1. Hourly routine messenger service.
2. All out-patients are assumed to have been pre-registered.
3. Average daily attendance: 325 out-patients plus 117 escorts.
4. The numbers of out-patients visiting other departments, returning to the clinic area or leaving the hospital direct are as shown in the data.

OUT-PATIENTS DEPARTMENT



This diagram shows the evaluated traffic links in descending order of importance between the subject department and each of the other 17 departments.

There is a separate diagram for each department constructed on the same basis and on the same scale.

Appendix B (5) (Data)

Department: Diagnostic X-ray

Code Number: 5

Movement—in and out (24 *hours*)	*Number of journeys*	*Department, code*	*Assessment*
Wards (from previous sheet)	—	1	259
Operating Theatre Suites (from previous sheet)	—	2	59
Pharmacy (from previous sheet)	—	3	18
Out-Patients Department (from previous sheet)	—	4	241
Out-patients			
From O.P.D. who then leave hospital direct (16+7)	23	16	78
From Accident and Emergency (9) + escorts	18 + 9	8	(72 + 27)×2
From General Practitioners and others (8)	16	16	64
Own Medical, Professional and Technical, Clerical and Ancillary Staff			
On duty	34	16	4¼
Off duty	34	16	4¼
Meals and breaks	102	12	13
Ad hoc	4	9	12
	2	8	2
Other Staff			
Maintenance	—	17	8
	1/10	16	2
Medical Records	3	10	3
Deliveries			
Clean linen	2/7	15	1½
Cleaning materials	1/14	13	—
Film and developing materials	1/14	16	1½
Hardware	1/30	13	—
Stationery	1/30	13	—
Collections			
Soiled linen	2/7	15	1½
Containers	2/7	13	1½
Silver	—	16	—
Collection/Delivery of post Round trips	3	6	3
	3	7	3
	3	8	3
	3	9	3
	3	10	3
	3	12	3
	3	13	3
	3	17	3
	3	18	3
Routine messenger service Collection/Delivery of all other items (for other departments) Round trips	8	6	7
	8	7	7
	8	8	7
	8	9	7
	8	10	7
	4	11	3½
	8	12	7
	8	13	7
	8	15	7
	8	17	7
	8	18	7

ANALYSIS

1	2	3	4	5	6	7	8	9
259	59	18	241	—	10	10	210	22

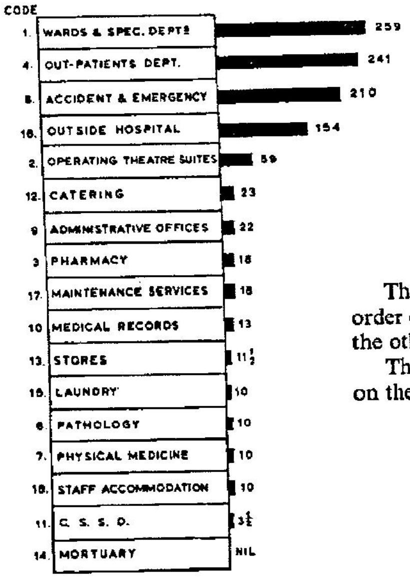
10	11	12	13	14	15	16	17	18
13	3½	23	11½	—	10	154	18	10

Notes

1. Hourly routine messenger service.
2. Average daily attendance: 70 (32 from O.P.D., 21 from the wards, 9 from Accident and Emergency and 8 from G.Ps and others).
3. Mobile X-ray normally kept in X-ray Department.

APPENDIX B (5) (Data) (continued)

DIAGNOSTIC X-RAY



This diagram shows the evaluated traffic links in descending order of importance between the subject department and each of the other 17 departments.

There is a separate diagram for each department constructed on the same basis and on the same scale.

Appendix B (6) (Data)

Department: Pathology
Code Number: 6

Movement—in and out (24 hours)		*Number of journeys*	*Department, code*	*Assessment*
Wards (from previous data sheets)		—	1	167
Operating Theatre Suites (from previous data sheets)		—	2	53
Pharmacy (from previous data sheets)		—	3	20
O.P.D. (from previous data sheets)		—	4	154
Diagnostic X-ray (from previous data sheets)		—	5	10
Out-Patients				
From O.P.D., who then leave hospital direct		15	16	60
Direct from outside hospital		11	16	44
Own Medical, Professional and Technical, Clerical and Ancillary Staff				
On duty		34	16	4¼
Off duty		34	16	4¼
Meals and breaks		102	12	13
Other journeys		4 16	8 14	12 40
Other Staff				
Maintenance		—	17	5
Deliveries				
Clean linen		2/7	15	1½
Cleaning materials		1/14	13	—
Blood, sera		3 2/7	8 16	6 6
Sterile supplies		2	11	6
Stationery		1/30	13	—
Hardware		1/30	13	—
Other supplies		1/14	16	1½
Collections				
Soiled linen		2/7	15	1½
Containers		2/7	13	1½
Blood, sera		2	8	6
C.S.S.D. (items returned)		—	11	—
Collection/Delivery of post	Round trips	3	7	3
		3	8	3
		3	9	3
		3	10	3
		3	12	3
		3	13	3
		3	17	3
		3	18	3
Routine messenger service Collection/Delivery of all other items (for other departments)	Round trips	8	7	7
		8	8	7
		8	9	7
		8	10	7
		4	11	3½
		8	12	7
		8	13	7
		8	15	7
		8	17	7
		8	18	7

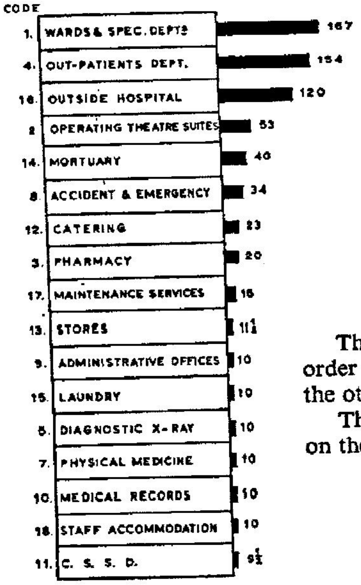
ANALYSIS

1	2	3	4	5	6	7	8	9
167	53	20	154	10	—	10	34	10

10	11	12	13	14	15	16	17	18
10	9½	23	11½	40	10	120	15	10

Notes
1. Hourly routine messenger service.
2. For the purpose of the study, it is assumed that a service is not being provided for other hospitals.
3. For the collection of blood specimens, two technicians make two round trips per day.
4. An incidence of no more than 5 per cent emergency reports which may require special delivery is assumed.

PATHOLOGY



This diagram shows the evaluated traffic links in descending order of importance between the subject department and each of the other 17 departments.

There is a separate diagram for each department constructed on the same basis and on the same scale.

Appendix B (7) (Data)

Department: Physical Medicine
Code Number: 7

Movement—in and out (24 hours)	*Number of journeys*	*Department, code*	*Assessment*
Wards (from previous sheet)	—	1	214
Operating Theatre Suites (from previous sheet)	—	2	7
Pharmacy (from previous sheet)	—	3	22
O.P.D. (from previous sheet)	—	4	52
Diagnostic X-ray (from previous sheet)	—	5	10
Pathology (from previous sheet)	—	6	10
Out-Patients			
From O.P.D., who leave hospital direct	12	16	48
To make clinical appointments after treatment	12	10	48
Direct attendances—for treatment (132+30)	324	16	1176
Own Professional, Technical, Clerical and Portering Staff			
On duty	20	16	2½
Off duty	20	16	2½
Meals and breaks	60	12	7½
Ad hoc	4 2	9 8	4 6
Deliveries			
Clean linen	2/7	15	1½
Cleaning materials	1/14	13	—
O.T. materials	1/30	13	—
Dressings	2/7	13	½
Stationery	1/30	13	—
Furniture, fittings, equipment	1/10	16	1
Maintenance	—	17	6
Collections			
Soiled linen	2/7	15	1½
Completed articles	1/7	13	½
Ambulances (14)	28	16	280
Collection/Delivery of post Round trips	3	8	3
	3	9	3
	3	10	3
	3	12	3
	3	13	3
	3	17	3
	3	18	3
Routine messenger service Collection/Delivery of all other items (for other departments) Round trips	8	8	7
	8	9	7
	8	10	7
	4	11	3½
	8	12	7
	8	13	7
	8	15	7
	8	17	7
	8	18	7

ANALYSIS

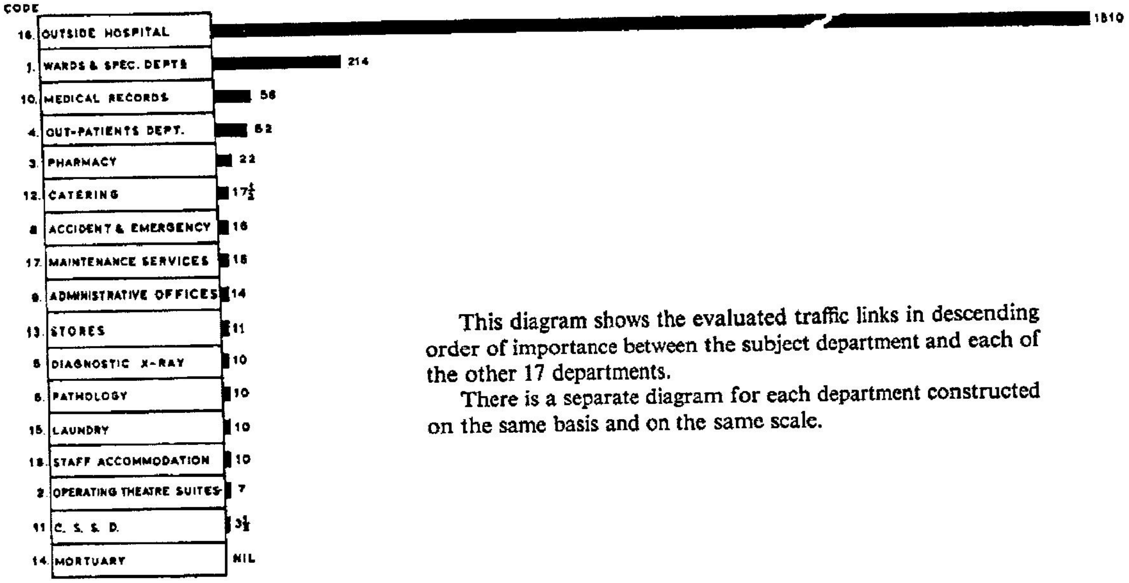
1	2	3	4	5	6	7	8	9
214	7	22	52	10	10	—	16	14

10	11	12	13	14	15	16	17	18
58	3½	17½	11	—	10	1510	16	10

Notes

1. Hourly routine messenger service.
2. Average daily attendances = 147 patients plus escorts (132 by appointment direct from outside the hospital, 9 from the Out-Patient Department to make appointments and 6 in-patients for treatment where special equipment or facilities are used).
3. The ratio between attendances for treatment and clinic attendances is estimated at 11: 1.
4. It is assumed that all other in-patient treatments are given in in-patient areas.

PHYSICAL MEDICINE



This diagram shows the evaluated traffic links in descending order of importance between the subject department and each of the other 17 departments.

There is a separate diagram for each department constructed on the same basis and on the same scale.

Appendix B (8) (Data)

Department: Accident and Emergency
Code Number: 8

Movement—in and out (24 hours)	*Number of journeys*	*Department, code*	*Assessment*
Wards (from previous data sheets)	—	1	252
Operating Theatre Suites (from previous data sheets)	—	2	110
Pharmacy (from previous data sheets)	—	3	22
O.P.D. (from previous data sheets)	—	4	10
Diagnostic X-ray (from previous data sheets)	—	5	210
Pathology (from previous data sheets)	—	6	34
Physical Medicine (from previous data sheets)	—	7	16
Out-patients (125) plus escorts (40)	165	16	580
Patients and escorts leaving	146	16	504
In-Patients			
Emergency (18)	18	—	—
Ambulances (11)	22	16	220
Own Medical, Nursing, Clerical and Ancillary Staff			
On duty	12	16	1½
	4	18	½
Off duty	12	16	1½
	4	18	½
Meals and breaks	48	12	6
Ad hoc and rounds	5	9	15
Maintenance	—	17	6
Deliveries			
Clean linen	4/7	15	3
Provisions	2/7	13	1½
Hardware	1/30	13	—
Stationery	1/30	13	—
C.S.S.D.	2	11	6
Dressings	2/7	13	1½
Case-notes (other than via messenger service)	24	10	48
Collections			
Soiled linen	4/7	15	3
C.S.S.D. items returned	—	—	—
Containers	2/7	13	1½
Case-notes	—	—	—
Mortuary	2	14	10
Collection/Delivery of post Round trips	3	9	3
	3	10	3
	3	12	3
	3	13	3
	3	17	3
	3	18	3
Routine messenger service Collection/Delivery of all other items (for other departments) Round trips	8	9	7
	8	10	7
	4	11	3½
	8	12	7
	8	13	7
	8	15	7
	8	17	7
	8	18	7

ANALYSIS

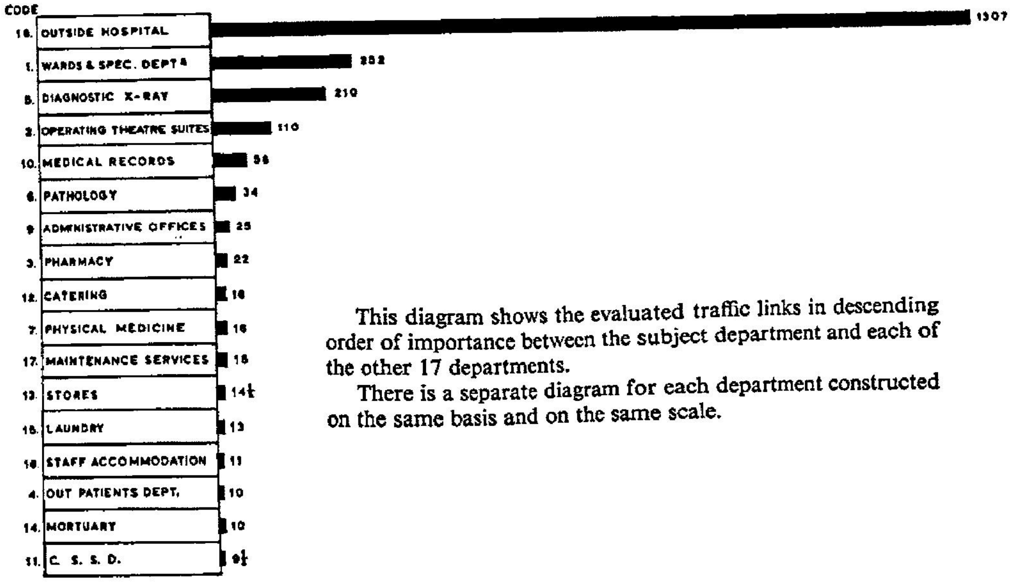
1	2	3	4	5	6	7	8	9
252	110	22	10	210	34	16	—	25

10	11	12	13	14	15	16	17	18
58	9½	16	14½	10	13	1307	16	11

Notes
1. Hourly routine messenger service.
2. Average daily attendance: 125 patients plus 40 escorts.

APPENDIX B (8) (Data) (continued)

ACCIDENT AND EMERGENCY



This diagram shows the evaluated traffic links in descending order of importance between the subject department and each of the other 17 departments.

There is a separate diagram for each department constructed on the same basis and on the same scale.

Appendix B (9) (Data)

Department: Administrative Offices

Code Number: 9

Movement—in and out (24 hours)	*Number of journeys*	*Department, code*	*Assessment*
Wards (from previous data sheets)	—	1	84
Operating Theatre Suites (from previous data sheets)	—	2	22½
Pharmacy (from previous data sheets)	—	3	14
O.P.D. (from previous data sheets)	—	4	56
Diagnostic X-ray (from previous data sheets)	—	5	22
Pathology (from previous data sheets)	—	6	18
Physical Medicine (from previous data sheets)	—	7	13
Accident and Emergency (from previous data sheets)	—	8	25
Out-Patients			
From O.P.D. to Almoner, then leave hospital	8	16	32
Own Administrative, Nursing, Professional and Technical, and Clerical Staff			
On duty	25	16	3
	4	18	½
Off duty	25	16	3
	4	18	½
Meals and breaks	87	12	11
Administrative rounds and visits	3	10	3
	3	11	5
	3	12	3
	3	18	5
Other Staff			
Enquiries, payments, etc.	18	12	18
	12	13	12
	24	15	24
	24	17	24
Maintenance	—	17	2
Visitors			
Enquiries, certificates, collecting fares, etc.	32	16	14
	8	10	16
Deliveries			
Cleaning materials	1/14	13	—
Stationery	2/30	13	—
Furniture and fittings	2/7	13	1½
Collection/Deliveries of post Round trips	3	10	3
	3	12	3
	3	13	3
	3	17	3
	3	18	3
Routine messenger service			
Collection/Delivery of all other items (for other departments) Round trips	8	10	7
	4	11	3½
	8	12	7
	8	13	7
	8	15	7
	8	17	7
	8	18	7

ANALYSIS

1	2	3	4	5	6	7	8	9
84	22½	14	56	22	18	13	25	—

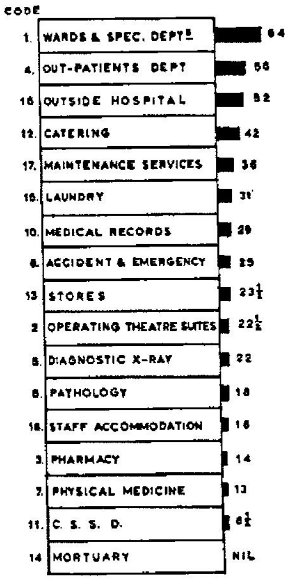
10	11	12	13	14	15	16	17	18
29	81½	42	23½	—	31	52	36	16

Notes

1. Hourly routine messenger service.
2. It is observed for the purpose of the study that the offices are staffed as shown in Building Note No. 18.

APPENDIX B (9) (Data) (continued)

ADMINISTRATIVE OFFICES



This diagram shows the evaluated traffic links in descending order of importance between the subject department and each of the other 17 departments.

There is a separate diagram for each department constructed on the same basis and on the same scale.

Appendix B (10) (Data)

Department: Medical Records

Code Number: 10

Movement—in and out (24 *hours*)	*Number of journeys*	*Department, code*	*Assessment*
Wards (from previous data sheets)	—	1	225
Operating Theatre Suites (from previous data sheets)	—	2	7
Pharmacy (from previous data sheets)	—	3	14
O.P.D. (from previous data sheets)	—	4	976
Diagnostic X-ray (from previous data sheets)	—	5	13
Pathology (from previous data sheets)	—	6	10
Physical Medicine (from previous data sheets)	—	7	58
Accident and Emergency (from previous data sheets)	—	8	58
Administrative Offices (from previous data sheets)	—	9	29
Out-patients			
From O.P.D. to make appointments, then leave hospital direct (198 +72 escorts)	270	16	936
Own Administrative and Clerical, Medical, Secretarial and Ancillary Staff			
On duty	22	16	2¾
Off duty	22	16	2¾
Meals and breaks	66	12	8
Ad hoc visits	1	13	1
	1	18	1
Maintenance	—	17	2
Enquiries	8	16	32
Deliveries			
Cleaning materials	1/14	13	—
Stationery	1/7	13	½
Furniture and fittings	1/14	13	—
Collection/Deliveries of post Round trips	3	12	3
	3	13	3
	3	17	3
	3	18	3
Routine messenger service			
Collection/Delivery of all other items (for other departments) Round trips	4	11	3½
	8	12	7
	8	13	7
	8	15	7
	8	17	7
	8	18	7

ANALYSIS

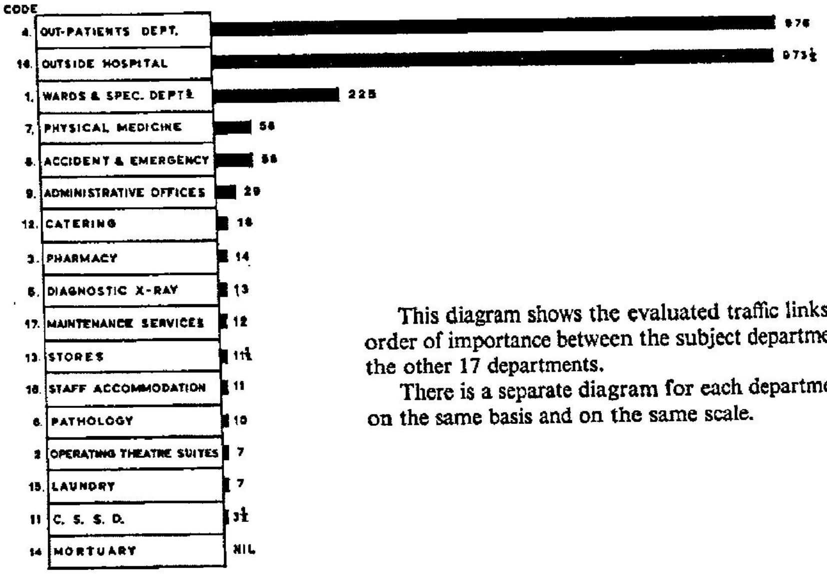
1	2	3	4	5	6	7	8	9
225	7	14	976	13	10	58	58	29

10	11	12	13	14	15	16	17	18
—	3½	18	11½	—	7	973½	12	11

Notes

1. Hourly routine messenger service.
2. Pre-registration of out-patients is observed.
3. See also Appendix B (4).

MEDICAL RECORDS



This diagram shows the evaluated traffic links in descending order of importance between the subject department and each of the other 17 departments.

There is a separate diagram for each department constructed on the same basis and on the same scale.

Appendix B (11) (Data)

Department: C.S.S.D.

Code Number: 11

Movement—in and out (24 hours)	*Number of journeys*	*Department, code*	*Assessment*
Wards (from previous data sheets)	—	1	45½
Operating Theatre Suites (from previous data sheets)	—	2	15½
Pharmacy (from previous data sheets)	—	3	15½
O.P.D. (from previous data sheets)	—	4	9½
Diagnostic X-ray (from previous data sheets)	—	5	3½
Pathology (from previous data sheets)	—	6	9½
Physical Medicine (from previous data sheets)	—	7	3½
Accident and Emergency (from previous data sheets)	—	8	9½
Administrative Offices (from previous data sheets)	—	9	8½
Medical Records (from previous data sheets)	—	10	3½
Own Staff			
On duty	11	16	1½
Off duty	11	16	1½
Meals and breaks	33	12	4½
Maintenance	—	17	3
Deliveries (own Department)			
Linen	2	15	8
Cleaning materials	2/7	13	½
Stationery	2/30	13	—
Hardware	2/30	13	—
Furniture and fittings	1/14	13	—
Medical and surgical supplies	2/7	13	½
Dressings	2/7	13	½
Packing materials	2/30	13	—
Collections (own Department)			
Containers	2/7	13	½
Routine messenger service			
Collection/Delivery of all other items (for other departments) Round trips	8	12	7
	8	13	7
	8	15	7
	8	17	7
	8	18	7

ANALYSIS

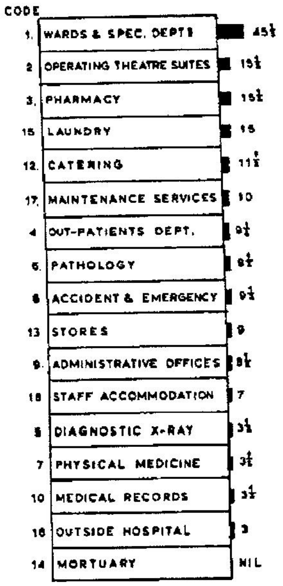
1	2	3	4	5	6	7	8	9
45½	15½	15½	9½	3½	9½	3½	9½	8½

10	11	12	13	14	15	16	17	18
3½	—	11½	9	—	15	3	10	7

Notes

1. Two-hourly routine messenger service.
2. For the purpose of the study the C.S.S.D. is assumed to be serving one hospital only.
3. Combined pick-up/delivery service by trolley.
4. A ratio of one trolley load per 90 beds has been used.
5. It is assumed that emergency cupboards and periodic review of assessments help eliminate *ad hoc* demands.

C.S.S.D.



This diagram shows the evaluated traffic links in descending order of importance between the subject department and each of the other 17 departments.

There is a separate diagram for each department constructed on the same basis and on the same scale.

Appendix B (12) (Data)

Department: Catering

Code Number: 12

Movement—in and out (24 hours)		*Number of journeys*	*Department, code*	*Assessment*
Wards (from previous data sheets)		—	1	570
Operating Theatre Suites (from previous data sheets)		—	2	20½
Pharmacy (from previous data sheets)		—	3	12½
O.P.D. (from previous data sheets)		—	4	22
Diagnostic X-ray (from previous data sheets)		—	5	23
Pathology (from previous data sheets)		—	6	23
Physical Medicine (from previous data sheets)		—	7	17½
Accident and Emergency (from previous data sheets)		—	8	22
Administrative Offices (from previous data sheets)		—	9	24
Medical Records (from previous data sheets)		—	10	18
C.S.S.D. (from previous data sheets)		—	11	11½
Own Staff				
On duty		50	16	6¼
Off duty		50	16	6¼
Maintenance		—	17	12
Deliveries				
Contractors' vehicles (1½)		3	16	30
Clean linen		1⅐	15	6
Provisions		12	13	36
Cleaning materials		2/14	13	½
Hardware and crockery		2/14	13	½
Furniture and fittings		2/30	13	—
Stationery		2/30	13	—
Collections				
Soiled linen		1⅐	15	6
Containers		2/7	13	1½
Meals and light refreshments (other staff)		12	13	1½
		4	14	½
		156	15	19½
		120	17	15
		180	18	22½
Collection/Delivery of post	Round trips	3	13	3
		3	17	3
		3	18	3
Routine messenger service Collection/Delivery of all other items (for other departments)	Round trips	8	13	7
		8	15	7
		8	17	7
		8	18	7

ANALYSIS

1	2	3	4	5	6	7	8	9
570	20½	12½	22	23	23	17½	22	24

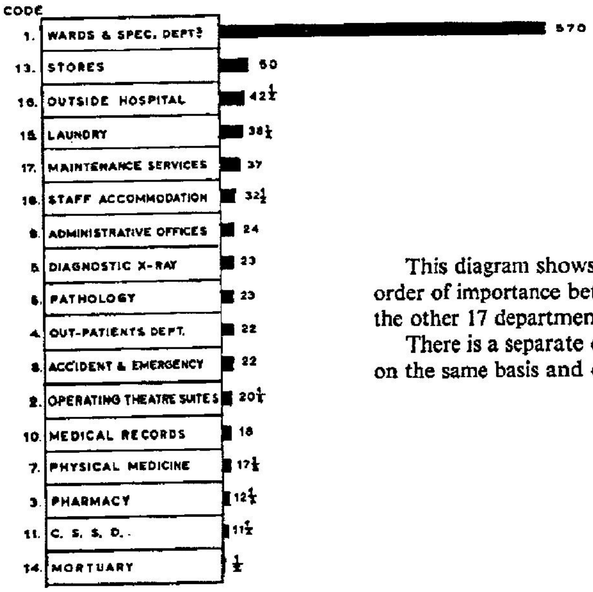
10	11	12	13	14	15	16	17	18
18	11½	—	50	½	38½	42½	37	32½

Notes

1. Hourly routine messenger service.
2. The catering department is assumed to include kitchens, dining-rooms and central crockery washing service.
3. The work load is estimated at 1,200 main meals daily.
4. Distribution of food is assumed to be by trolley.

APPENDIX B (12) (Data) (continued)

CATERING



This diagram shows the evaluated traffic links in descending order of importance between the subject department and each of the other 17 departments.

There is a separate diagram for each department constructed on the same basis and on the same scale.

Appendix B (13) (Data)

Department: Stores

Code Number: 13

Movement—in and out (24 hours)	*Number of journeys*	*Department, code*	*Assessment*
Wards (from previous data sheets)	—	1	204
Operating Theatre Suites (from previous data sheets)	—	2	16
Pharmacy (from previous data sheets)	—	3	13
O.P.D. (from previous data sheets)	—	4	26½
Diagnostic X-ray (from previous data sheets)	—	5	13
Pathology (from previous data sheets)	—	6	11½
Physical Medicine (from previous data sheets)	—	7	11
Accident and Emergency (from previous data sheets)	—	8	14½
Administrative Offices (from previous data sheets)	—	9	23½
Medical Records (from previous data sheets)	—	10	11½
C.S.S.D. (from previous data sheets)	—	11	9
Catering (from previous data sheets)	—	12	50
Own Staff			
On and off duty	12	16	1½
Deliveries (to own departments)			
Contractors' vehicles (8 per day)	16	16	160
Containers	2/7	15	1½
Containers	2/7	18	1½
Distribution (to other departments)			
Provisions	2	18	6
Cleaning materials Round trips	1/14	14	—
	3/7	15	3
	1/14	17	—
	1/14	17	—
New bedding, linen, patients' clothing, textiles and staff uniform	3/7	15	3
Haberdashery	1/30	15	—
Hardware and crockery	1/30	15	½
	1/30	18	½
Furniture and fittings	2	18	6
Stationery	1/30	15	—
	1/30	17	—
	1/30	18	—
Collection/Delivery of post Round trips	3	17	3
	3	18	3
Routine messenger service			
Collection/Delivery of all other items (for other departments) Round trips	8	15	7
	8	17	7
	8	18	7

ANALYSIS

1	2	3	4	5	6	7	8	9
204	16	13	26½	13	11½	11	14½	23½

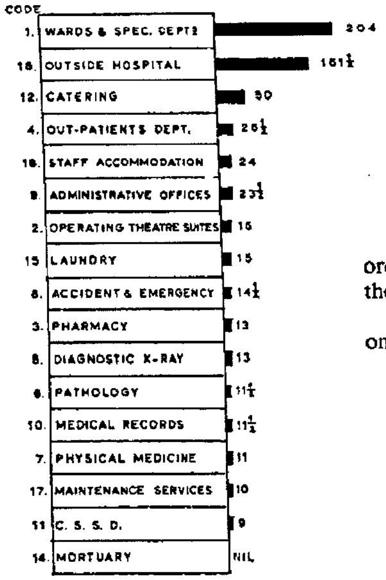
10	11	12	13	14	15	16	17	18
11½	9	50	—	—	15	161½	10	24

Notes

1. Hourly routine messenger service.
2. Distribution is assumed to be by trolley.
3. Frequency of supply—see Appendix B (1).

APPENDIX B (13) (Data) (continued)

STORES



This diagram shows the evaluated traffic links in descending order of importance between the subject department and each of the other 17 departments.

There is a separate diagram for each department constructed on the same basis and on the same scale.

Appendix B (14) (Data)

Department: Mortuary

Code Number: 14

Movement—in and out (24 hours)	*Number of journeys*	*Department, code*	*Assessment*
Wards (from previous data sheets)	—	1	17½
Operating Theatre Suites (from previous data sheets)	—	2	3
Pharmacy (from previous data sheets)	—	3	2
O.P.D. (from previous data sheets)	—	4	—
Diagnostic X-ray (from previous data sheets)	—	5	—
Pathology (from previous data sheets)	—	6	40
Physical Medicine (from previous data sheets)	—	7	—
Accident and Emergency (from previous data sheets)	—	8	10
Administrative Offices (from previous data sheets)	—	9	—
Medical Records (from previous data sheets)	—	10	—
C.S.S.D. (from previous data sheets)	—	11	—
Catering (from previous data sheets)	—	12	½
Stores (from previous data sheets)	—	13	—
Visitors	12	16	1½
Vehicles (4)	8	16	80
Maintenance	—	17	1

ANALYSIS

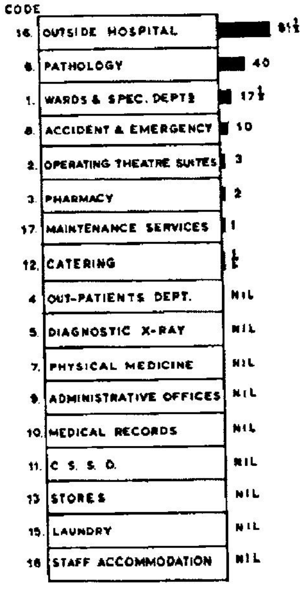
1	2	3	4	5	6	7	8	9
17½	3	2	—	—	40	—	10	—

10	11	12	13	14	15	16	17	18
—	—	½	—	—	—	81½	1	—

Notes

1. Included in messenger service if required; two-hourly or twice daily service.

MORTUARY



This diagram shows the evaluated traffic links in descending order of importance between the subject department and each of the other 17 departments.

There is a separate diagram for each department constructed on the same basis and on the same scale.

Appendix B (15) (Data)

Department: Laundry, etc.
Code Number: 15

Movement—in and out (24 hours)	*Number of journeys*	*Department, code*	*Assessment*
Wards (from previous data sheets)	—	1	153
Operating Theatre Suites (from previous data sheets)	—	2	23
Pharmacy (from previous data sheets)	—	3	7
O.P.D. (from previous data sheets)	—	4	13
Diagnostic X-ray (from previous data sheets)	—	5	13
Pathology (from previous data sheets)	—	6	13
Physical Medicine (from previous data sheets)	—	7	10
Accident and Emergency (from previous data sheets)	—	8	13
Administrative Offices (from previous data sheets)	—	9	31
Medical Records (from previous data sheets)	—	10	7
C.S.S.D. (from previous data sheets)	—	11	15
Catering (from previous data sheets)	—	12	22
Stores (from previous data sheets)	—	13	15
Mortuary (from previous data sheets)	—	14	—
Own Staff (laundry, linen room, sewing room)			
On duty	40	16	5
Off duty	40	16	5
Distribution/Collection of linen	2¼	18	14
Uniforms, fittings, repairs, etc.	16	18	2
Maintenance	—	17	12
Routine messenger service			
Collection/Delivery of all other items .. .. .. Round trips	8 8	17 18	7 7

ANALYSIS

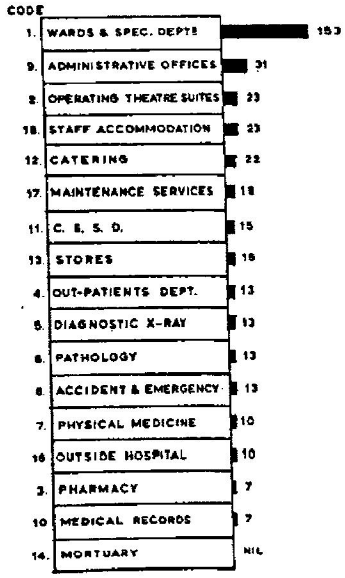
1	2	3	4	5	6	7	8	9
153	23	7	13	13	13	10	13	31

10	11	12	13	14	15	16	17	18
7	15	22	15	—	—	10	19	23

Notes

1. Hourly routine messenger service.
2. For the purpose of the study, the laundry is assumed to be on the same site as the hospital and serving that hospital only.
3. The laundry is assumed to include central linen and sewing rooms.
4. Collection and distribution is by trolley.

LAUNDRY



This diagram shows the evaluated traffic links in descending order of importance between the subject department and each of the other 17 departments.

There is a separate diagram for each department constructed on the same basis and on the same scale.

Appendix B (16) (Data)

Department: Outside the hospital

Code Number: 16

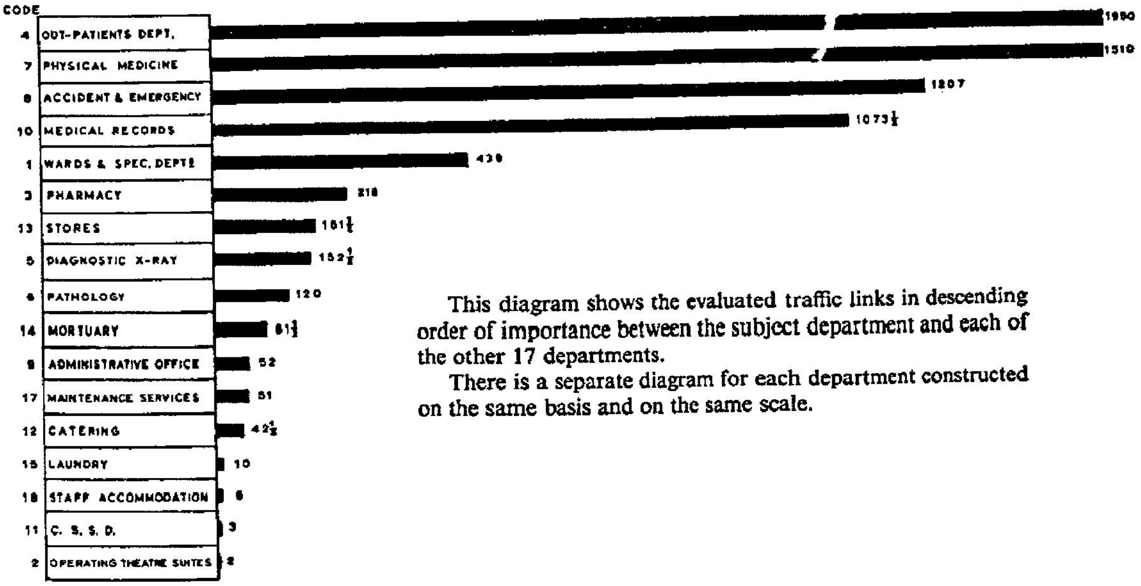
Movement—in and out (24 hours)	*Number of journeys*	*Department, code*	*Assessment*
Wards (from previous data sheets)	—	1	439
Operating Theatre Suites (from previous data sheets)	—	2	2
Pharmacy (from previous data sheets)	—	3	218
O.P.D. (from previous data sheets)	—	4	1950
Diagnostic X-ray (from previous data sheets)	—	5	152½
Pathology (from previous data sheets)	—	6	120
Physical Medicine (from previous data sheets)	—	7	1510
Accident and Emergency (from previous data sheets)	—	8	1207
Administrative Offices (from previous data sheets)	—	9	52
Medical Records (from previous data sheets)	—	10	1073½
C.S.S.D. (from previous data sheets)	—	11	3
Catering (from previous data sheets)	—	12	42½
Stores (from previous data sheets)	—	13	161½
Mortuary (from previous data sheets)	—	14	81½
Laundry (from previous data sheets)	—	15	10
Contractors' Vehicles (2) Engineering and building stores	4	17	40
Maintenance Staff (including clerical, stores)			
On duty	43	17	5½
Off duty	43	17	5½
Nursing and Ancillary Staff			
On duty	24	18	3
Off duty	24	18	3

ANALYSIS

1	2	3	4	5	6	7	8	9
439	2	218	1950	152½	120	1510	1207	52

10	11	12	13	14	15	16	17	18
1073½	3	42½	161½	81½	10	—	51	6

OUTSIDE THE HOSPITAL



This diagram shows the evaluated traffic links in descending order of importance between the subject department and each of the other 17 departments.

There is a separate diagram for each department constructed on the same basis and on the same scale.

Appendix B (17) (Data)

Department: Maintenance Services
Code Number: 17

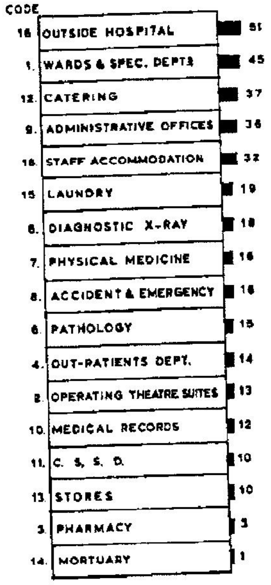
Movement—in and out (24 hours)		*Number of journeys*	*Department, code*	*Assessment*
Wards (from previous data sheets)		—	1	45
Operating Theatre Suites (from previous data sheets)		—	2	13
Pharmacy (from previous data sheets)		—	3	13
O.P.D. (from previous data sheets)		—	4	14
Diagnostic X-ray (from previous data sheets)		—	5	18
Pathology (from previous data sheets)		—	6	15
Physical Medicine (from previous data sheets)		—	7	16
Accident and Emergency (from previous data sheets)		—	8	16
Administrative Offices (from previous data sheets)		—	9	36
Medical Records (from previous data sheets)		—	10	12
C.S.S.D. (from previous data sheets)		—	11	10
Catering (from previous data sheets)		—	12	37
Stores (from previous data sheets)		—	13	10
Mortuary (from previous data sheets)		—	14	1
Laundry, etc. (from previous data sheets)		—	15	19
Outside the hospital (from previous data sheets)		—	16	51
Maintenance Staff Accommodation		—	18	22
Collection/Delivery of post	Round trips	3	18	3
Routine messenger service Collection/Delivery of all other items (for other departments)	Round trips	8	18	7

ANALYSIS

1	2	3	4	5	6	7	8	9
45	13	13	14	18	15	16	16	36

10	11	12	13	14	15	16	17	18
12	10	37	10	1	19	51	—	32

Notes
1. Hourly routine messenger service.
2. Building and engineering maintenance is assumed to be based on a planned annual programme.



MAINTENANCE SERVICES

This diagram shows the evaluated traffic links in descending order of importance between the subject department and each of the other 17 departments.

There is a separate diagram for each department constructed on the same basis and on the same scale.

Appendix B (18) (Data)

Department: Staff Accommodation

Code Number: 18

Movement—in and out (24 hours)	*Number of journeys*	*Department, code*	*Assessment*
Wards (from previous data sheets)	—	1	196
Operating Theatre Suites (from previous data sheets)	—	2	14
Pharmacy (from previous data sheets)	—	3	10
O.P.D. (from previous data sheets)	—	4	14
Diagnostic X-ray (from previous data sheets)	—	5	10
Pathology (from previous data sheets)	—	6	10
Physical Medicine (from previous data sheets)	—	7	10
Accident and Emergency (from previous data sheets)	—	8	11
Administrative Offices (from previous data sheets)	—	9	13
Medical Records (from previous data sheets)	—	10	11
C.S.S.D. (from previous data sheets)	—	11	7
Catering (from previous data sheets)	—	12	32½
Stores (from previous data sheets)	—	13	23½
Mortuary (from previous data sheets)	—	14	—
Laundry, etc. (from previous data sheets)	—	15	23
Outside the hospital (from previous data sheets)	—	16	6
Maintenance Services (from previous data sheets)	—	17	32

ANALYSIS

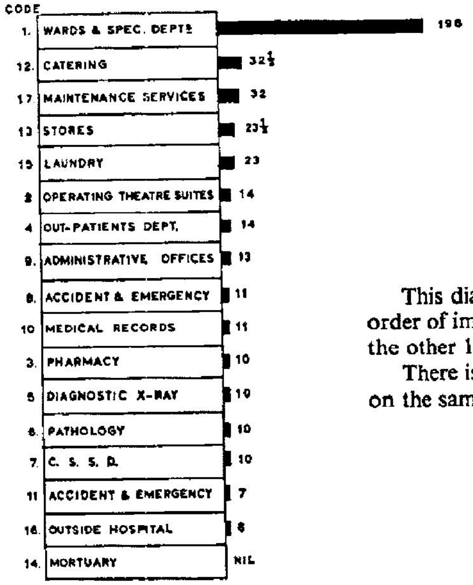
1	2	3	4	5	6	7	8	9
196	14	10	14	10	10	10	11	13

10	11	12	13	14	15	16	17	18
11	7	32½	23½	—	23	6	32	—

Notes

1. Hourly routine messenger service.
2. Based on the provision of residential accommodation for one-third of the trained nurses and two-thirds of the remainder. In addition, it is assumed that there will be accommodation for 22 medical staff.

STAFF ACCOMMODATION



This diagram shows the evaluated traffic links in descending order of importance between the subject department and each of the other 17 departments.

There is a separate diagram for each department constructed on the same basis and on the same scale.

Appendix C

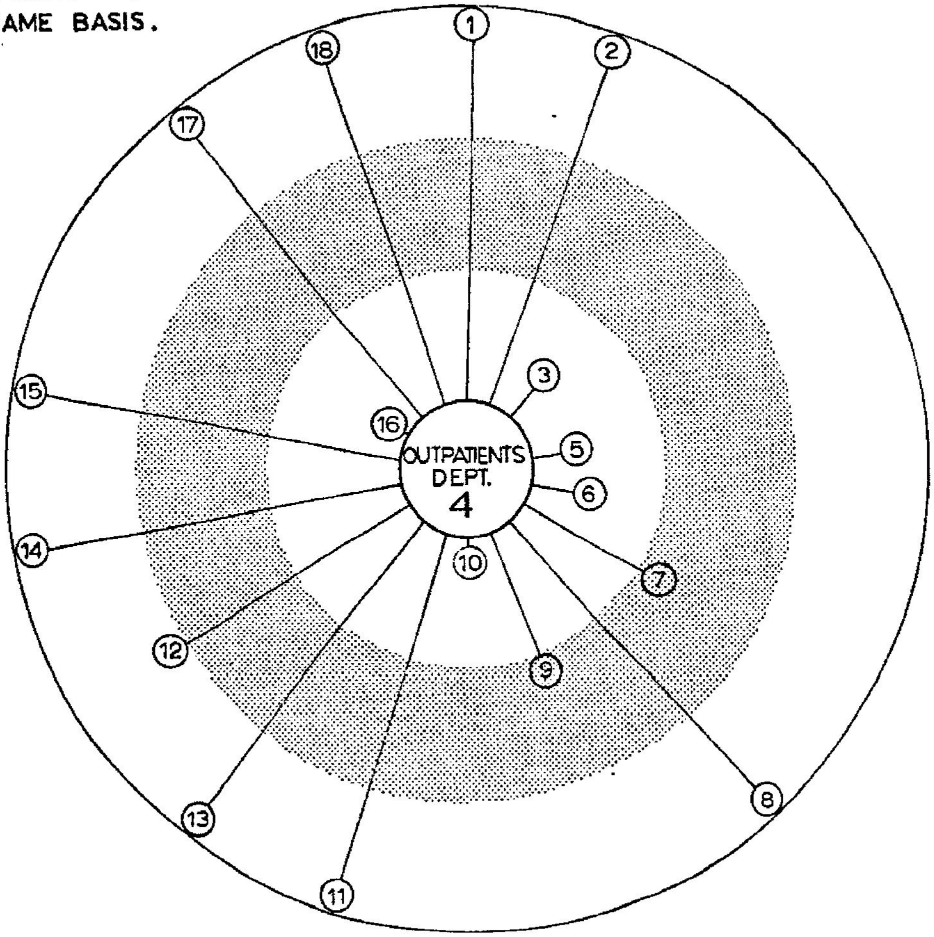
OUT-PATIENTS DEPARTMENT

THIS DIAGRAM IS FOR ILLUSTRATION ONLY.

IT COMPARES THE EVALUATED NEEDS OF HOSPITAL DEPARTMENTS TO BE NEAR THE DEPARTMENT SHOWN IN THE CENTRE CIRCLE — THE OUT-PATIENTS DEPARTMENT.

THE NEARER TO THE CENTRE A DEPARTMENT IS SHOWN, THE MORE IMPORTANT IS THE LINK.

A SEPARATE DIAGRAM FOR EACH DEPARTMENT, CAN BE CONSTRUCTED ON THE SAME BASIS.



KEY

1. WARDS & SPEC. DEPTS
2. OPERATING THEATRE SUITES
3. PHARMACY
4. OUT-PATIENTS DEPT.
5. DIAGNOSTIC X-RAY
6. PATHOLOGY
7. PHYSICAL MEDICINE
8. ACCIDENT & EMERGENCY
9. ADMINISTRATIVE OFFICES
10. MEDICAL RECORDS
11. C. S. S. D.
12. CATERING
13. STORES
14. MORTUARY
15. LAUNDRY
16. OUTSIDE HOSPITAL
17. MAINTENANCE SERVICES
18. STAFF ACCOMMODATION

Appendix C (I)

NOTES ON THE METHOD OF CONSTRUCTION OF A RECIPROCAL DIAGRAM

The stages in the construction of a reciprocal diagram, an example of which is reproduced for illustration only, are as follows:

(*a*) The evaluated traffic data for the example at Appendix C were:

Code No.		*Points*
4	**Out-patient Department**	Subject Dept.
16	Outside the hospital	1950
10	Medical Records	976
5	Diagnostic X-ray	244
3	Pharmacy	196
6	Pathology	154
9	Administrative Offices	56
7	Physical Medicine	52
12	Catering	25
13	Stores	16½
17	Maintenance	14
18	Staff Accommodation	14
15	Laundry	13
1	Wards and Special Departments	10
8	Accident and Emergency	10
11	C.S.S.D.	9½
2	Operating Theatre Suites	7
14	Mortuary	Nil

The higher the evaluation, the more important was the link, but the figures as they stand could not be used for showing *graphically* the comparative attraction to the subject department.

(*b*) To construct the diagram it was therefore necessary to change the figures so that without affecting comparative relationships to the subject department, the smallest number denoted the most important link and the largest the most remote. This is done simply by converting each number to its reciprocal (e.g. 1950 becomes 1/1950, 10 becomes 1/10).

(*c*) The final stage is to multiply throughout by a number chosen to give results which will fit conveniently the size and scale of diagram required.

(*d*) For the purpose of the illustration, which had necessarily to be restricted in size, the calculation was as follows:

Code No.	*Reciprocal*		*No. chosen*		
16	1/1950	×	220	=	1/9 approx.
10	1/976	×	220	=	2/9
5	1/244	×	220	=	11/12
3	1/196	×	220	=	1⅛
6	1/154	×	220	=	1 3/7
9	1/56	×	220	=	4
7	1/52	×	220	=	4 3/13
12	1/25	×	220	=	8⅘
13	1/16½	×	220	=	13⅓
17	1/14	×	220	=	15 5/7
18	1/14	×	220	=	15 5/7
15	1/13	×	220	=	17
1	1/10	×	220	=	22
8	1/10	×	220	=	22
11	1/9½	×	220	=	23
2	1/7	×	220	=	31
14	1/0	×	220	=	inf.

The figures in the end column could then be used to show graphically the comparative attraction to the subject department of the other seventeen. To conform to the small size of the illustration it was necessary to choose a unit of one quarter-inch and to position the departments along radii of 2¾ in. measured from the circumference of the centre circle to the circumference of a code-number circle at its furthest point from the centre. In order to retain easily distinguishable differences between the more important links, the less important—which would have been more than 2¾ in. from the centre—have been allowed to congregate around the outer perimeter.

(*e*) For normal use, a larger scale is desirable and the number of departments or functions included will depend on the requirements of the study being made.

Appendix D

INTER-RELATION OF DEPARTMENTS
EVALUATED TRAFFIC DATA

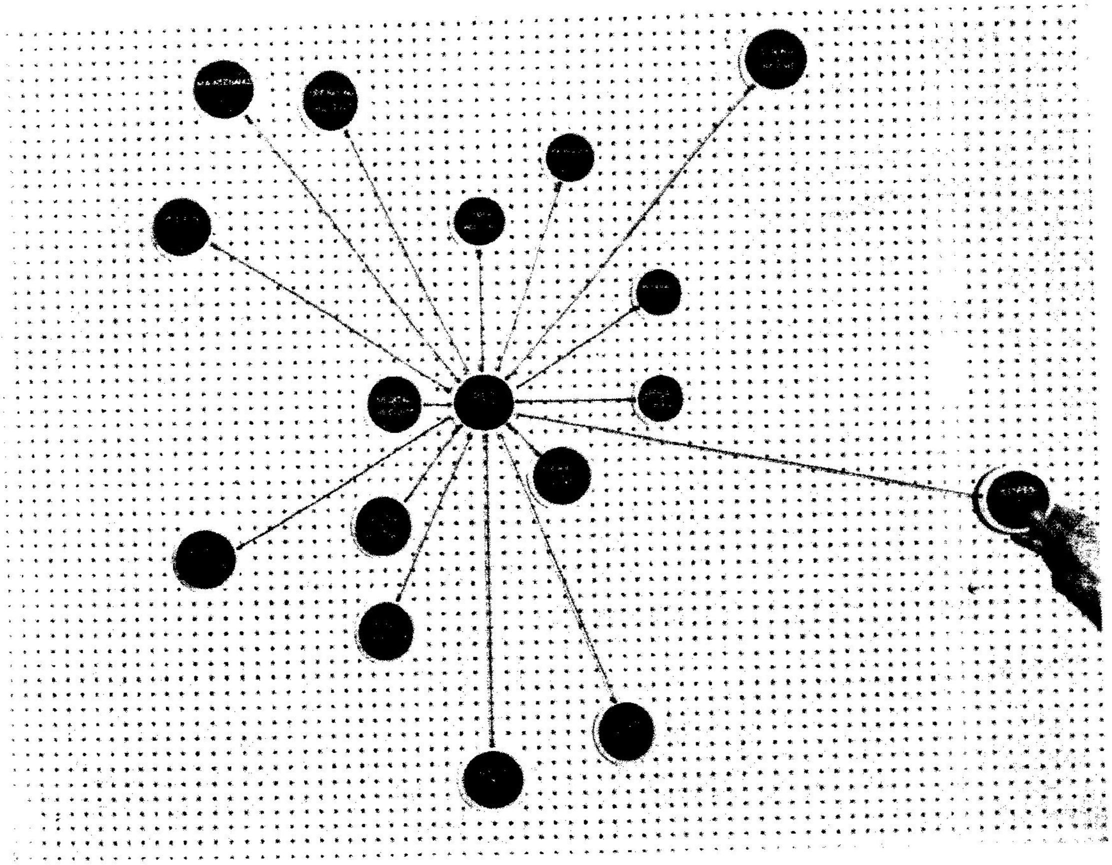
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1		686	151	10	259	157	214	282	84	252	45½	667½	204	17½	153	440	45	196
2			30	7	63	51	7	110	22½	7	15½	20½	16	3	23	2	13	14
3				196	18	20	22	28	14	14	15½	12½	13	2	7	221	13	10
4					244	154	52	10	56	976	9½	25	16½	—	13	1950	14	14
5						10	10	210	2½	13	3½	23	11½	—	10	154	18	10
6							10	34	10	10	9½	23	11½	40	10	120	15	10
7								16	14	58	3½	17½	11	—	10	1510	16	10
8									25	58	9½	16	14½	10	13	1307	16	11
9										29	8½	42	23½	—	31	52	36	16
10											3½	18	11½	—	7	973½	12	11
11												11½	9	—	15	3	10	7
12													50	½	38½	42½	37	32½
13														—	15	161½	10	24
14															—	81½	1	—
15																10	19	23
16																	51	6
17																		32
18																		

KEY

1. Wards and Special Departments
2. Operating Theatre Suites
3. Pharmacy
4. O.P.D.
5. Diagnostic X-ray
6. Pathology
7. Physical Medicine
8. Accident and Emergency
9. Administrative Offices
10. Medical Records
11. C.S.S.D.
12. Catering
13. Stores
14. Mortuary
15. Laundry
16. Outside the hospital
17. Maintenance Services
18. Staff Accommodation

Appendix E

A PLANNING BOARD



The above photograph shows a simple and inexpensive planning board in use. The board consists of one piece of 6 ft. by 4 ft. perforated hardboard finished with two coats of white emulsion paint. Two sizes of white enamelled wooden ceiling-rose drilled through the centre are used to represent departments and are attached to the board by means of hooks. The hooks pass through the centres of the wooden discs and on these projections identity discs of white-lettered black matt cardboard are hung. Types and densities of traffic are represented by brightly coloured thread or hat elastic attached to coloured map pins driven into the rim of the wooden discs.

The advantage of this design is its high degree of flexibility. Identities of departments can be switched simply by changing the cardboard discs, and the moving of a whole assembly of hook and wooden disc is a one-hand operation. If elastic is used to represent traffic it is often possible to move departments about without unduly disturbing the arrangement.

The black and white matt surfaces of the board and the discs are purposely designed to simplify the making of photographic records of arrangements. Slides for showing to groups are easily produced and, if desired, colour photography can be used to distinguish the traffic lines. The board can also be used for the examination of problems of interior layouts and the construction of string and other kinds of diagrams.

The total cost of the materials for the board illustrated was £3 15s. 3d.

Arrangement shown above is for purpose of illustration only.

Appendix F

SOME ADDITIONAL FACTORS WHICH AFFECT THE SITING OF DEPARTMENTS IN HOSPITALS

The following are not in order of priority; decisions on which are the most important will in each case depend on local circumstances.

ACCESS	To site and building
ADAPTABILITY	
ENGINEERING SERVICES	Economical use
EXPANSION	Building
FIRE PREVENTION, PROTECTION AND ESCAPE	
NOISE	For example, traffic on or off site, aircraft, industry
PRIVACY	Visual and audial
RESTRICTIONS	Existing buildings and other features on the site
SHARING FACILITIES	For example, staff lavatories, plaster room, sterilising plant
SIMPLICITY OF LAYOUT	For ease of orientation
SMOKE, SMELL AND DUST	
SOIL CONDITIONS	Effect on structure and building
VIEW	Both as an amenity and need to screen
WEATHER	Exposure to wind, sun

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